REMARKS

Applicant respectfully requests reconsideration and allowance of the subject application. Claims 1-25 were pending.

Applicant has herein amended claims 1 and 5-7, cancelled claim 8, and added new claim 26. Accordingly, claims 1-7 and 9-26 are now pending. Support for the amendments is found at page 9, lines 3-7, for example.

The Claimed Invention

The claimed invention is a multi-band antenna that operates in both the PCS band and the AMPS band. The antenna comprises two slot antenna elements, a transmission line to feed the slot antennas, and a reflector element. The antenna design allows the reflector element to be positioned one-sixth of a PCS band wavelength and one-thirteenth of an AMPS wavelength from the radiating elements. Configuring the antenna with two slots, one for each band, and directly coupling only one of the slots to the feed while parasitically coupling the other slot antenna through the first slot antenna permits a reflector to be placed very close to the slots to create such a short cavity. This design is beneficial because such an electrically short cavity allows the antenna to be compact enough to be mounted to the top of a front windshield in a vehicle without interfering with visibility, while at the same time preventing radiation from entering into the passenger compartment of the vehicle, which has become a health concern in recent years.

The Rejection

The Office rejected all pending claims, i.e., claims 1-25, under 35 U.S.C. §103(a) as obvious over Sabet in view of Eason. Claim 1 is the only independent claim.

With respect to claim 1, the Office asserted that Sabet teaches first and second slot antennas 32, 34 and transmission lines 38, 40 to feed the slots. The Office conceded that Sabet does not teach a reflector, as claimed in claim 1. However, the Office asserted that Eason (previously cited for different teachings) discloses a reflector 44 in Figure 10. The Office recognizes that element 44 in Figure 10 of Eason is a ground plane, not a reflector. However, in the Response to Arguments section of the Office Action, the Office asserted that a ground plane qualifies as a reflector because "A ground plane is a reflector of electromagnetic energy, because it reflects incident electromagnetic energy as is very well known in the art".

The Sabet Reference

Sabet discloses a multifunction printed antenna with GPS in which satellite radio patch antenna elements are printed on one side of the printed circuit board and AMPS, PCS, GSM, and terrestrial radio slot antennas are etched in a ground plane on the opposite side of the same printed circuit board.

The Eason Reference

Eason discloses a fractal cross slot antenna having a ground plane 44 that is positioned relatively close to the radiating element.

Applicant's Response

Applicant respectfully traverses. The proposed combination of Sabet and Eason is improper. MPEP §2143 lists the three fundamental requirements for a proper rejection based on obviousness, namely:

> First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

In the present case there is neither any suggestion or motivation in the prior art to make the proposed combination nor could there be any reasonable expectation of success. In fact, the combination suggested by the Office "to use the reflector of Eason with the radiating element disclosed in Sabet to obtain an improved antenna" would not result in an improved antenna. It would result in a non-operational antenna. Particularly, one of the problems addressed by the present invention is the fact that we wish to reduce radiation from the antennas into the passenger compartment of the vehicle. However, the addition of a reflector will completely alter the impedance and Q (i.e., bandwidth) of the antenna. Particularly, it will reduce both the Q and the impedance. However, the impedance must be matched to the device which is being fed. Otherwise, the power input to the device will be reflected at the interface between the device and the antenna. Without proper impedance matching, most of the energy could be reflected back. This is why reflectors are almost always placed about ¼ or ½ of a wavelength away from the slot antenna, rather than the $1/13^{th}$ for the AMPS band (and $1/6^{th}$ for the PCS band) that has been achieved in the present invention. Specifically, by using phase

superposition by setting the spacing between the radiator and the reflector surface at ¼ or ½ of a wavelength, phase superposition solves the impedance matching problem. In the present invention, the inventors are able to place the reflector rear plane so close to the slots by effectively adjusting the impedance of the antennas by parasitically coupling them to each other, thereby effectively changing their impedance.

If one were to place Eason's reflector in Sabet's antenna, the impedance and Q would both plummet and the result would be an antenna with significant impedance mismatch and the wrong Q, i.e., a non-operational antenna in any practical sense.

The only reason that Eason can place his reflector close to his radiating element is because Eason's antenna is a fractal antenna, not a conventional slot antenna. Fractal antennas operate on a completely different principle than the slot antennas of the present invention and Sabet. There is absolutely no reason to believe that anything that Eason teaches about a reflector used with a fractal antenna would have any applicability to an antenna having two relatively narrow band slot antennas, like Sabet. In fact, it does not have any applicability. Making the proposed combination will result in a non-operational antenna.

In the present invention, we have two relatively narrow band antennas operating at two different frequencies. A fractal antenna is a very wide band antenna. Eason talks about the bandwidth of his antenna covering two GPS bands. In Eason's fractal antenna, that is one wide band, not two separate narrow bands. Eason can place his ground plane 44 close to the antenna because, in a fractal

antenna, which has a very wide bandwidth, the changes that this will cause in the Q and the impedance are negligible.

Placing that same reflector in Sabet's antenna design, in the other hand, makes that antenna essentially non-operable.

Turning to the language of claims 1, it expressly recites first and second slot antennas operating in the PCS and AMPS bands, respectively, and that the reflector is positioned $1/13^{th}$ of a wavelength of the AMPS band from the radiating element. This is not found in the prior art.

Since claims 2-25 depend from claim 1, they also are not obvious over Sabet and Eason.

Nevertheless, the dependent claims even further distinguish over the prior art of record. Claim 6, for instance, expressly recites that "the reflector and the radiating element together form a reflecting cavity that is generally rectangular in shape". Obviously, Eason's ground plane 44 does not form a cavity with the radiating element since it is not in electrical contact with the radiating element. Dependent claim 6 further recites that the distance between the back wall of the reflector and the radiating element is between 0.75 and 1.25 inches. The Office asserts that Eason meets this limitation because it teaches a distance between the ground plane and the radiating element of 0.5 inches (col. 6, lines 54-55) "which is approximately the same distance and very close to the same electrical distance".

Applicant respectfully traverses. 0.5 inches is not between 0.75 and 1.25 inches. Therefore, this limitation is not found in the prior art.

Furthermore, Applicant has added new dependent claim 26, which recites that "said reflector forms a rectangular reflection cavity together with said radiating

element". Eason's ground plane is not U shaped and does not form a rectangular cavity with the radiating element.

Even further, claim 4 adds that "the radiating element further comprises a GPS patch antenna." The Office asserted that a GPS patch antenna is shown as 298 in Figure 19 of Sabet. While Sabet discloses that element 298 is a GPS antenna, Sabet does not meet the limitations of claim 4 because claim 4 recites that the GPS antenna is part of the previously claimed radiating element that also contains the two slot antennas. In Sabet, antenna 298 is not part of the radiating element containing the other two antennas. Rather, it is a separate component on a separate substrate 296. Accordingly, claim 4 even further distinguishes over Sabet.

With respect to dependent claim 11, the Office asserted that Sabet teaches that the first and second slot antennas 32, 34 disclosed in Figures 1 and 4 of Sabet are parasitically coupled "due to their close relative positioning".

Applicant respectfully traverses. Figure 1 of Sabet shows an antenna with only a single slot antenna. Accordingly, there is no possibility that Figure 1 discloses or suggests parasitically coupling two antennas. Figure 4, on the other hand, does disclose two antennas. However, quite clearly they are not parasitically coupled. Feed stub 36 branches out into feed stub 38 to antenna 32 and feed stub 40 to antenna 34. Thus, both antennas are fed directly by conductors. There is no parasitic coupling in this circuit. The mere fact that the two antennas are close to each other does not mean that they are parasitically coupled. The fact that they both are directly fed from conductor 36 is the opposite of parasitic coupling. Any interpretation of the term parasitic coupling that reads on two directly fed antennas

simply makes the term meaningless, which obviously is not a reasonable interpretation of any term.

With respect to claims 12, 15, and 17, which recite specific dimensions of the slot antennas, the Office simply asserts without citation or other support that these dimensions are disclosed in Sabet. They are not.

Conclusion

In view of the foregoing amendments and remarks, this application is now in condition for allowance. Applicant respectfully requests the Examiner to issue a Notice of Allowance at the earliest possible date. The Examiner is invited to contact Applicant's undersigned counsel by telephone call in order to further the prosecution of this case in any way.

Respectfully Submitted,

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